(206) 932-4116 x-329
FAX (206) 932-3803

EVERGREEN RECYCLING, INC.

5400 W Marginal Way SW
Seattle, WA 98106

October 23, 1996

Jill Trohimovich, Sr. Environmental Health Specialist
Solid Waste Program
Seattle King County Department of Health
Environmental Health Division
Room 201 Smith Tower
Seattle, WA 98104

Re: **Holnam Inc. - Solid Waste Treatment Permit**

Dear Jill:

In accordance with your letter dated August 24, 1995, Holnam would like to provide an update to the **Acceptable Materials** list. The material of interest is auto shredder residue. Attached is the TCLP data for the material we plan to manage.

PROCESS: Automotive and appliance recycling creates three streams with recycling potential. The first is steel scrap. This material is utilized by the mini-mill industry to produce recycled steel. The second and third are the shredded combination of plastics and iron oxide. While there is not currently an outlet for the plastic material, the iron oxide fines which are produced from the rust which forms on steel is an iron bearing material which can be utilized by Holnam in its process.

HANDLING AT GENERAL METALS: Steel in the form of cars and appliances is received by General Metals at their Tacoma wrecking yard. Materials are loaded into a hammer mill and subsequently shredded into steel scrap, plastics and iron. Steel is separated on a magnetic conveyor while the iron and plastics are conveyed on for disposal. General Metals will separate the heavy iron from the plastic like materials to create a segregated stream for use as a raw material at Holnam. Holnam will test the material to ensure it passes leachability for heavy metals D004 - D011. Volumes will be comprised initially to material that accumulates through leakage from the General Metals conveyor system. Material in the size range < 1/4 inch fall off of the conveyors in the quantity of 12 tons per day. Holnam will receive this material every three days until General Metals installs a screen. At that time, estimated to be one year from commencement, Holnam would increase its intake.

HANDLING AT HOLNAM: Holnam will receive General Metals material in the volume of 70 tons per week with the option to go to 35 tons per day or more. The material will be delivered to Holnam by the transporter and placed under covered storage while awaiting utilization in the cement making process. The material will then be blended to supplement existing iron streams. All auto shredder residue received by Holnam will be run through a 3/8 inch minus screen. For the purpose of eliminating the potential for excessive organic content in the material, cement chemistry will be run periodically to keep losses from organics and moisture below 20%. The material will replace other iron sources for the kiln which utilizes iron as a flux comprising approximately 3% of the total raw mix volume.

SAMPLING AT GENERAL METALS: Samples have been taken from the inventory in storage at General Metals. Samples are comprised of 10 grabs composited into one sample. Analytical was performed at Philip Environmental's Washington State DOE certified laboratory located in Renton, WA. This sampling method and analysis was performed over several weeks as the pile was formed. Results are attached.

ATTACHMENTS

1. Holnam Material Certification Form
2. TCLP Results
3. Cement Chemstry Results

Holnam would like to move the existing inventory for the purpose of evaluating the material in the cement making process. Current inventory comprises approximately 70 tons. Please contact me at your convenience to discuss this further or proceed with approval. My number in Seattle is 932-4116 x-328.

Regards,

David Lahaie
Evergreen Recycling Inc.

HOLNAM INC.
NON-HAZARDOUS RAW MATERIAL SUBSTITUTE CERTIFICATION FORM AND INDEMNITY
EXHIBIT B-2

This document must be completed in its entirety and signed by the potential customer before Holnam will consider accepting materials. If Holnam is willing to accept materials, it will notify customer by sending a Materials Approval Form. All services are governed by the terms of the Terms of Engagement or Master Services Agreement.

Material Profile Number: ______________________

General Information

A. **Generator**
Name: General Metals of Tacoma, Inc.
Address: 1902 Marine View Dr.
Contact: Rick Buse Telephone: (206) 572-4000
State/EPA ID #: ______________________
(if available)

B. **Transporter**
Name: ISI
DOT Identification Number: ______________________
Contact: David Lahaie Telephone: 932-4111 x-228

C. **Consultant**
Name: ______________________
Contact: ______________ Telephone: ______________

D. **Billing Address** (if different than generator)
Address ______________________
____
Contact: ______________ Telephone: ______________

Information About Material

Material (check appropriate category):

___Tires	___Fly Ash	___Iron Slag
___Petroleum Contaminated Soils	___Foundry Sand	___Diatomaceous Earth
___Sandblast Grit	___Aluminum Silicate	___Mulite Sludge
___Bottom Ash	___Crushed Brick	✓Other: Iron oxide from steel recycling

Estimated Volume of Material: 10,000 t/year
Original Location of Material: General Metals of Tacoma
Owner of Original Location: General Metals of Tacoma
Lessee of Original Location: N/A
Description of Process/Activity that Generated Material: Shredding of automobiles & appliances – Material comprises Iron + Silica (glass)
Has anything been added to the material? If so, what?
No
Does the material contain any of the following? If so, what percentage? (Check appropriate categories):
___Cobble, Concrete or Asphalt (0 %) ___Woodwaste (0 %) ___Metal debris (0 %)
___Oversized materials (0 %)
Shipping Vessel (e.g., containers, truck bed, tanker truck, etc): Truck

Cement Chemistry Analysis

Sodium Oxide	___%	Silica	26 %	Nickel	– ppm
Potassium Oxide	___%	Aluma	5 %	Copper	– ppm
LOI	___%	Iron Oxide	55 %	Zinc	– ppm
Chloride	___%	Calcium Oxide	10 %	Arsenic	0.1 ppm
Material Density	___%	Magnesium Oxide	2 %	Barium	117 ppm
Gasoline Content	___%	Sulfur Oxide	0.5 %	Cadmium	0.5 ppm
Diesel/Oil Content	___%	Lead	2.5 ppm	Chromium	0.01 ppm
Phosphoric Oxide	___%	Silver	0.01 ppm	Mercury	___ ppm
Mercury	0.05 %	Selenium	0.6 ppm		

Materials Profile. Generator certifies that the following tests have been completed with the following results (check appropriate categories):

	Not Required (Holnam to check appropriate box)	Date Performed (completed by customer)
Materials sampled and analyzed per WAC 173-303-110		
Materials analyzed and not: • ignitable per WAC 173-303-090(5)	✓	
• corrosive per WAC 173-303-090(6)	✓	
• reactive per WAC 173-303-090(7)	✓	
• toxic per WAC 173-303-090(8)	✓	
• listed per WAC 173-303-090	✓	
• toxic per WAC 173-303-100(a)	✓	
• persistent per WAC 171-303-100(b)	✓	
• carcinogenic per WAC 171-303-100(c)	✓	

Certification:

Generator certifies, represents and warrants that (1) the Material is not dangerous or extremely hazardous waste under RCW 70.105 or WAC 173-303; (2) the Material contains no solvents or PCBs; and (3) copies of all tests performed on any samples from the Material certified herein are attached. Generator further certifies, represents and warrants that, to the best of its knowledge, (4) there have been no alterations or material changes in the character of the Material after the analyses were performed that would render those analyses inaccurate; and (5) the samples analyzed are representative of the Material to be tendered pursuant to this certification. For purposes of this Agreement, certifications (4) and (5) mean that Materials must be analyzed at least every 12 months or immediately after there is any change in the process generating the Material or the Material itself.

This document (including its attachments) is hereby incorporated into the MASTER SERVICE AGREEMENT for _______________ executed by ____________________ and __________________________ on ______, 199_ ("Agreement"). If there are conflicts between this Certification and the Agreement, the Agreement's terms shall prevail.

______________________________ ______________

Signature of Company's Authorized Agent Date

INDEMNITY BY COMPANY

Holnam's Acceptance of PCS is based on the information provided by your company on this PCS Certification Form, the associated test data and other representations of your company. Your company shall absolutely and unconditionally protect, defend, indemnify and save harmless Holnam and its present and future officers, directors, shareholders, agents and employees of Holnam from and against any and all fines, loss, damage, injury, liability to or death of any person, costs of response to any governmental inquiry, request, or requirement or for loss of or damage to property or for loss or damage arising from attachments, liens or claims of material men or laborers, claims and reasonable attorneys' fees and costs relating to any of the foregoing ("Claims"), resulting from Company's activities, from Company's tender of Non-conforming Materials or from Company's breach of the Agreement, whether or not Holnam, or its officers, directors, shareholders, agents or employees was or is claimed to be concurrently or comparatively negligent, and regardless of whether liability without fault is imposed, or sought to be imposed, on Holnam. The foregoing indemnification shall not apply to the extent that such indemnity is void or otherwise unenforceable under applicable law in effect on or validly retroactive to the date of this Agreement, or the date of the claim, and shall not apply where such Claims are the result of the sole negligence or willful misconduct of Holnam. It is intended that the foregoing indemnity shall be broad and comprehensive. This indemnity shall survive the expiration or other termination of this Agreement. This indemnity is for the sole benefit of Holnam and not for the benefit of any third party.

CHEMICAL ANALYSIS

HOLNAM

SAMPLE #1 IRON DATE

Screened

SiO₂ / R₂O₃ / MgO / SO₃ / Loss

SiO_2	29.15
Al_2O_3	5.68
Fe_2O_3	21.05
CaO	8.19
MgO	2.23
SO_3	1.80
Na_2O	1.37
K_2O	0.26
NaEq	1.54
Loss	34.14
Total	
CEMENT COMPOUNDS	
CaO	
C_3A	
C_4AF	
C_3S	
C_2S	
$CaSO_4$	
Total	
Analyst	

Analysis 10/14

CHEMICAL ANALYSIS

HOLNAM

SAMPLE #2 IRON DATE

SiO_2

R_2O_3

Yes

MgO

SO_3

Loss

SiO_2	26.14
Al_2O_3	4.71
Fe_2O_3	55.28
CaO	9.19
MgO	1.70
SO_3	0.55
Na_2O	0.08
K_2O	0.15
NaEq	
Loss	14.02
Total	
CEMENT COMPOUNDS	
CaO	
C_3A	
C_4AF	
C_3S	
C_2S	
$CaSO_4$	
Total	
Analyst	

PHILIP ENVIRONMENTAL

BY-PRODUCT RECOVERY GROUP
WESTERN REGION

Philip Environmental Laboratory
955 Powell Avenue S.W.
Renton, WA 98055-2908
TEL 206.227.6110
FAX 206.227.6196

Analytical Report

David LaHaie
To: ~~MARK FOSTER~~
~~Commercial Sales~~ ERI
~~1100 Oakesdale Ave S.W.~~
~~Renton WA 98055~~

Report Date: 10/22/96	Generator: ERI	Work Order No.: 62498
Sample Collected: 10/18/96	Project Name: ERI	P.O. No.:
Received Date: 10/18/96	Project No:	Job Number: 96100210

Client ID: #1

Profile #:
Lab ID: AA11341

Analyte	**Method**	**Result**	**Units**
METALS			
TCLP Metals			
Arsenic	EPA 6010	< 0.114	mg/L
Barium	EPA 6010	1.44	mg/L
Cadmium	EPA 6010	0.298	mg/L
Chromium	EPA 6010	0.0207	mg/L
Lead	EPA 6010	1.34	mg/L
Mercury	EPA 6010	< 0.057	mg/L
Selenium	EPA 6010	0.483	mg/L
Silver	EPA 6010	< 0.0114	mg/L

Data Reviewed By: Bill Ambaker

Data Reported By: Bill Ambaker

PHILIP
ENVIRONMENTAL
BY-PRODUCT RECOVERY GROUP
WESTERN REGION

Philip Environmental Laboratory
955 Powell Avenue S.W.
Renton, WA 98055-2908
TEL 206.227.6110
FAX 206.227.6196

Analytical Report

To: MARK FOSTER
Commercial Sales
1100 Oakesdale Ave S.W.
Renton WA 98055

Report Date: 10/09/96	Generator: HOLNAM CEMENT	Work Order No.: 62194
Sample Collected: 10/08/96	Project Name: HOLNAM CEMENT	P.O. No.:
Received Date: 10/08/96	Project No:	Job Number: 96100091

Client ID:#1
Profile #:
Lab ID: AA10957

Analyte	**Method**	**Result**	**Units**
METALS			
TCLP Metals			
Arsenic	EPA 6010	<0.114	mg/L
Barium	EPA 6010	1.57	mg/L
Cadmium	EPA 6010	0.422	mg/L
Chromium	EPA 6010	0.0473	mg/L
Lead	EPA 6010	3.83	mg/L
Mercury	EPA 6010	<0.057	mg/L
Selenium	EPA 6010	<0.342	mg/L
Silver	EPA 6010	<0.0114	mg/L

TO: DAVID LAWAIE
PAGES: 1 OF 2

PHILIP
ENVIRONMENTAL
BY-PRODUCT RECOVERY GROUP
WESTERN REGION

Philip Environmental Laboratory
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Renton, WA 98055-2908
TEL 206.227.6110
FAX 206.227.6196

Analytical Report

To: MARK FOSTER
Commercial Sales
1100 Oakesdale Ave S.W.
Renton WA 98055

Report Date: 10/09/96	Generator: HOLNAM CEMENT	Work Order No.: 62194
Sample Collected: 10/08/96	Project Name: HOLNAM CEMENT	P.O. No.:
Received Date: 10/08/96	Project No:	Job Number: 96100091

Client ID: #2

Profile #:
Lab ID: AA10958

Analyte	Method	Result	Units
TCLP Metals			
Arsenic	EPA 6010	<0.114	mg/L
Barium	EPA 6010	1.51	mg/L
Cadmium	EPA 6010	0.334	mg/L
Chromium	EPA 6010	0.0976	mg/L
Lead	EPA 6010	1.81	mg/L
Mercury	EPA 6010	<0.057	mg/L
Selenium	EPA 6010	<0.342	mg/L
Silver	EPA 6010	<0.0114	mg/L

Data Reviewed By: Sam

Data Reported By: [signature]

TO: DAVID LAWAIE
PAGES: 2 OF 2

PHILIP
ENVIRONMENTAL
BY-PRODUCT RECOVERY GROUP
WESTERN REGION

Philip Environmental Laboratory
955 Powell Avenue S.W.
Renton, WA 98055-2908
TEL 206.227.6110
FAX 206.227.6196

Analytical Report

To: MARK FOSTER
Commercial Sales
1100 Oakesdale Ave S.W.
Renton WA 98055

Report Date: 10/04/96	**Generator:** HOLNAM	**Work Order No.:** 62077
Sample Collected: 10/03/96	**Project Name:** EVERGREEN	**P.O. No.:**
Received Date: 10/03/96	**Project No:**	**Job Number:** 96100045

Client ID: ERJ

Profile #:
Lab ID: AA10743

Analyte	Method	Result	Units
METALS			
TCLP Metals			
Arsenic	EPA 6010	< 0.114	mg/L
Barium	EPA 6010	1.77	mg/L
Cadmium	EPA 6010	0.503	mg/L
Chromium	EPA 6010	0.0141	mg/L
Lead	EPA 6010	2.55	mg/L
Mercury	EPA 6010	< 0.057	mg/L
Selenium	EPA 6010	0.638	mg/L
Silver	EPA 6010	< 0.0114	mg/L

Data Reviewed By: Sm

Data Reported By: [signature]

DATE: 10/04/96
TO: DAVID LAHAIE
PAGES: 1

DELTA

CRITICAL REVIEW OF WASHINGTON STATE DEPARTMENT OF ECOLOGY'S "CEMENT KILNS AS SOURCES OF DIOXIN-LIKE CONTAMINANTS: AN INITIAL REVIEW FOCUSING ON HOLNAM INC., SEATTLE, WA"

NOVEMBER 7, 1996

DELTA TOXICOLOGY INC.
2601 Elliott Ave.
Suite 4315
Seattle, WA 98121

206.443.2115 phone
206.443.2117 facsimile

INTRODUCTION TO COMMENTS

The Washington State Department of Ecology (WDOE) has prepared a draft document entitled "Cement Kilns as a Source of Dioxin-like Contaminants - An Initial Review Focusing on HOLNAM INC., Seattle, WA." This report was authored by WDOE staff and was released for preliminary review on February 20, 1996. There are a number of problems with this document, including:

- The WDOE document is undirected and wanders. It presents scattered pieces of information related to dioxins but does not develop a well-supported case that HOLNAM'S Seattle kiln presents health risks. Although it claims at the outset to address "potential risks," it fails to do so. The farthest it gets, in most cases, is simply to compare emission rates to discharge rates from several unrelated sources of dioxins.
- The document is unabashedly focused on HOLNAM, but provides no basis for such a focus. It does this despite acknowledgment of Ash Grove's nearby kiln and other emission sources. This seems inappropriate for a regulatory agency with an obligation to be even-handed in its approach to the regulated community and begs for an explanation/justification.
- The document reflects inadequate preparation on the part of its creators, even for a draft. There are repeated instances within the document of referring to information that is yet to be obtained.
- The analyses that are provided are drastically oversimplified and reaching. These analyses ignore most variation and uncertainties, even those emphasized in documents to which the author chiefly refers. It further ignores publications in the scientific community critiquing the referenced materials.
- The document presents a curious set of data to compare with HOLNAM'S emissions and CKD. These include the release rate of dioxins in effluent from a Canadian pulp mill and regulatory limits of dioxins in the Columbia River. Alternatively, the document neglects to compare HOLNAM'S air emissions to health-based air emission standards or to emissions of incinerators or other cement kilns and HOLNAM'S CKD to fly and bottom ash from municipal waste incinerators (MWI), much more obvious and appropriate comparisons. According to information presented in EPA's Dioxin Reassessment documents[1], non-hazardous waste-burning cement kilns and CKD from such kilns (like the HOLNAM facility) represent only 0.4% of annual dioxin TEQ air emissions attributed to cement kilns and 0.01% of the annual MWI total ash TEQ generation rate, respectively.
- Many of the recommendations in the document are, as a result, based on flawed reasoning, and a general lack of data. Implementation of many such recommendations would, in our opinion, be arbitrary and lacking foundation.

[1] EPA, 1994a,b.

As a result, DELTA TOXICOLOGY (DELTA) comments on the paper and suggests more appropriate means of examining the dioxin and furan content in cement kiln dust (CKD) and in air emissions from cement kilns (the HOLNAM INC. plant in Seattle, Washington, in particular). DELTA includes comparisons to other significant sources to provide a better perspective on the contribution that cement kilns make to the generation of dioxins and furans and their associated health risks.

The WDOE paper is included verbatim, in its entirety, with DELTA'S responses following in bold, italic print.

In our comments, unless otherwise noted, the use of the term "dioxins" refers to 2,3,7,8-TCDD toxicity equivalent (TEQ) values for 2,3,7,8-substituted dioxins and 2,3,7,8-substituted furans.[2]

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[2] The Toxicity Equivalency Factor (TEF) scheme referred to in the WDOE document and used in our comments is assumed to be the one presented in EPA, 1994a,b.

DRAFT
Cement Kilns as Sources of Dioxin-like Contaminants
An Initial Review Focusing on Holnam Inc., Seattle, WA

February 20, 1996
Bill Yake

SUMMARY: This document summarizes information on actual and potential discharges of dioxin-like chemicals from cement kilns – especially those like the Holnam kiln that burn auxiliary fuel/waste including medical wastes and "tire-derived fuel." Potential risks associated with allowing continued application of cement kiln dust (CKD) to agricultural lands are discussed. Recommendations for action are provided.

Comments:

1. The purpose of this document is not clearly stated in the summary.

2. HOLNAM'S Seattle plant (HOLNAM) does not burn hazardous or medical waste as a supplementary fuel source.

3. Dioxin content in air emissions and CKD are referenced, but no "risks associated with allowing continued application of CKD to agricultural lands" are actually presented. Risks associated with HOLNAM'S air emissions are also not presented or discussed.

4. Considering all of the combustion sources - such as cement kilns, industrial boilers, and incinerators - that exist in the state of Washington, it is not clear why HOLNAM alone is chosen for review in this document.

5. The term "dioxin-like chemicals" used in the summary needs to be clarified, because other dioxin-like chemicals, such as polychlorinated biphenyls (PCBs) and polybrominated biphenyls (PBBs), are not mentioned in this article.

Suggestions:

1. Clarify the purpose or objective of the document.

2. Verify information (e.g., HOLNAM'S fuel sources) and clarify terms (e.g., "dioxin-like chemicals") used within the document.

3. For the purpose of discussing risks, provide a qualitative explanation, or quantitative estimates, of the risks.

4. Either explain the reasoning for selecting only HOLNAM, or include a review of other appropriate facilities.

INTRODUCTION

In the fall of 1995 the Department of Ecology's (Ecology's) Risk Assessment Forum (RAF) reviewed the draft EPA dioxin risk assessment issued in June of 1994. In addition to EPA's draft health assessment of dioxin (EPA, 1994a) which evaluated medical evidence regarding the immunotoxicity, developmental/reproductive toxicity and carcinogenicity of dioxin and dioxin-like chemicals, EPA issued a second document (EPA, 1994b) that examined physical properties, sources, occurrence and background exposures to these compounds. Review of these reports raised concerns about a number of potential sources and practices that might contribute to human exposure to these chemicals. This paper provides a review of issues related to one of the sources addressed by EPA: cement kilns. It focuses on Holnam, Inc., a cement kiln located on the Duwamish tide flats that augments its fuel with tire-derived fuel (TDF) and "Sterifuel" (shredded, sterilized medical waste).

General Comments:

WDOE is using a reference[3] that has been subsequently reviewed and criticized, and this paper fails to incorporate that subsequent body of literature.[4] The EPA's Science Advisory Board (SAB) also conducted a thorough review of the Dioxin Reassessment documents and provided numerous suggestions for improvement.[5]

Specific comments:

1. With regard to WDOE's above statements, the SAB review found the following:

- ***Sections of the report focusing on the carcinogenicity, immunotoxicity, and developmental toxicity of dioxins were in need of varying degrees of refinement.***
- ***Although the dioxin source inventory was generally reasonable, it was in need of revision and updating in two areas: (1) incorporating new findings, and (2) the issue of uncertainty associated with "engineering assessments and emission data availability."[6]***

Incorporation of these uncertainties into EPA's Dioxin Reassessment documents would likely have a large impact on the range of their dioxin emission estimates, and

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[3] EPA, 1994a,b.
[4] Clapp et al., 1995; EPA, 1995a; Greenberg et al., 1995; Johnson, 1995; Stone, 1994.
[5] EPA, 1995a.
[6] EPA, 1995a.

thus on the comparisons one could make based on this information. WDOE fails to address this issue.

2. Expressing that a compound is toxic, without reference to dose and exposure, is meaningless. Toxicity is always a function of dose and exposure. This fact is a fundamental principle of toxicology.

3. If WDOE is implying that dioxins from HOLNAM stack gases are a hazard, then it failed to review properly all of the available data. For example, estimated ground-level dioxin concentrations based on HOLNAM'S 1995 and 1996 stack tests were below WDOE's Acceptable Source Impact Level (ASIL) of 3.0×10^{-8} $\mu g/m^3$ and EPA's Risk-based Concentration (RBC) of 5.0×10^{-8} $\mu g/m^3$.[7,8] This was true for all tested sources of fuel, including coal, coke, chipped rubber tires, non-hazardous waste oil, natural gas and Sterifuel®.

4. Sterifuel® has only been used by HOLNAM in test burns to determine if it <u>can</u> be an acceptable supplemental fuel. It is not currently used as a supplemental fuel.

5. HOLNAM does <u>not</u> burn medical waste as a supplementary fuel source, nor has it performed test burns with medical waste. Sterifuel® is <u>not</u> considered a medical waste; it is treated as a fuel or solid waste. There are two primary reasons for Sterifuel®'s classification: (1) sharps are separated from the regulated healthcare waste stream, and (2) the remainder is then ground and sterilized before being disposed of or being used as a fuel source.[9] As a result, Sterifuel® is neither infectious nor recognizable as medical waste.

<u>Suggestions:</u>

1. Incorporate the referenced literature in the final version of WDOE's paper.

2. Compare estimated concentrations related to HOLNAM dioxin generation to selected EPA and WDOE guideline values to estimate possible health risks, instead of simply listing a compound's adverse health effects without respect to its concentration or to the routes of exposure.

3. Verify the fuel sources at HOLNAM and the extent of their use.

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[7] The RBC is a calculated concentration that corresponds to a target risk (or hazard quotient) for a single contaminant in a single medium, under standard default exposure assumptions (U.S. EPA, 1995b).
[8] DELTA TOXICOLOGY, 1995.
[9] Perry et al., 1996.

BACKGROUND

Several pertinent pieces of information provided by the EPA dioxin assessment (EPA, 1994a,b) were:

- 2,3,7,8-TCDD (tetrachlorodibenzodioxin, or simply "dioxin") is the most toxic of a family of chlorinated dibenzodioxins and furans (CDD/Fs).

<u>*Comments:*</u>

1. This comment should be more informative. Presenting a single congener does not adequately describe the family of chlorinated organic compounds known as dioxins and furans.

2. Referring to the toxicity of 2,3,7,8-TCDD without discussing the current state of scientific knowledge on the compound (e.g., from animal and epidemiological studies) is misleading.

<u>*Suggestions:*</u>

1. Present a brief discussion on the following: (1) explain what dioxins and furans are, (2) explain that different congeners are not of equal toxicity, and (3) explain the basis of the Toxic Equivalency Factors (TEFs) approach.

2. Address statements of dioxin toxicity in relation to the recent literature, which describes the findings and limitations of pertinent animal studies and of human epidemiological studies.[10]

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[10] Our review of the toxicological and epidemiological studies have indicated the following. For humans, the information regarding the long-term toxicity is not clear. In August 1992, EPA published a review draft of an eight-volume report entitled "Health Assessment for 2,3,7,8-TCDD and Related Compounds" (EPA, 1992). Chapter seven of this EPA report, "Epidemiology/Human Data", concludes with the following summary statement of human health effects, reprinted below in its entirety:

"Although there is considerable literature reporting the effects of human exposure to 2,3,7,8-TCDD contaminated materials, the data do not describe one condition or a series of long-term health effects which are consistent among every exposed population. Results of clinical cross-sectional studies provide the most consistent information, suggesting that some effects are transient, particularly increased liver enzyme levels and urinary porphyrins, and that other effects may persist in some individuals, particularly chloracne, and elevated lipid levels. However, these data are unable to determine the characteristics which distinguish individuals with persistent effects from those without."

This statement reflects the general scientific consensus that a significant amount of uncertainty remains regarding dioxins' ability to cause any long-term health effects, including cancer end-points, on the general population. Chloracne is the only adverse health effect that has been linked to dioxin exposure (EPA, 1995a), although studies on the most reasonably well-characterized populations suggest that the onset of the skin ailment tends to result from very high body burdens (i.e., >800 ppt in adipose tissue) (HSDB, 1996; Gough, 1991). However, even at such high body burdens, there is not a consistent trend between body burden levels and the onset of chloracne.

- Other CDD/Fs have been assigned toxicity factors (TFs) that express their toxicity relative to "dioxin." The total toxicity of a mixture of CDD/Fs is expressed as toxicity equivalents (TEQs).

<u>*Comment:*</u>

This statement should be more informative. Although using TEFs/TEQs is a generally accepted approach for assessing the toxicity of chlorinated organic compounds that are structurally similar and exhibit similar toxicological responses, some concerns do exist regarding their use. The SAB reviewed a number of these issues (e.g., adjustments to several TEF values, assessing synergistic and antagonistic effects, etc.) and they should be integrated into any scientific document on dioxins.

<u>*Suggestion:*</u>

Provide a brief explanation of the basis of the TEFs, how TEFs are utilized in the TEQ approach, and the limitations and caveats that should be kept in mind when using the TEFs.

- Dioxins and furans are quite refractive; that is, they are persistent in the environment. They can, therefore, cycle for a long time (decades) through the air, water, sediment, soil, and the food web. Additionally, mass balance comparisons provided in the assessment imply that "reservoir sources" (e.g. recycled CDD/F) may be responsible for as much as 15 times the amount released from new sources annually.

<u>*Comments:*</u>

1. The term "refractive" is not commonly used in the literature to describe the environmental persistence of a compound of concern.

2. The stability of dioxins under most environmental conditions is generally accepted. However, some environmental degradation or transformation processes should be considered to describe more accurately the qualified persistence of dioxins in the environment.

Furthermore, soil concentrations believed to cause chloracne in susceptible individuals (i.e., >100,000 ppb) (HSDB, 1996) via dermal exposure are nearly eight orders of magnitude above levels detected in Holnam CKD (i.e., 0.0015 ppb, assuming 100% of the detection limit for non-detects) (TLI, 1996).

Epidemiological studies examining the correlation between exposure to dioxins and the development of cancer have been inconclusive. Much of what is known about dioxins' capacity to cause cancer is based primarily on results from short-term assays and animal (i.e., rat and mice) studies. As for the case of any compound of concern, extrapolation of results from animals to humans is always a source of uncertainty and must be considered when making judgments based on such data.

3. There is no discussion of the movement of dioxins through different environmental media (i.e., air, water, soil, etc.). Evaluation of dioxin movement through soil is of particular interest because of the land application of CKD.

4. Although reservoir sources of dioxins is a topic of value, it is unclear why it is being included in this WDOE document.

Suggestions:

1. Simply describe dioxins and furans as being persistent in the environment. Use of the term "refractive" is unnecessary, and is either peculiar or incorrect.

2. Provide a brief discussion on some of the important environmental degradation or transformation processes including the following:

- *Photodegradation of dioxins in their gaseous phase, at surface soil levels, and at the water-air interface;[11,12] and*
- *Hydroxyl reactions with vapor-phase dioxins.[13,14]*

3. Present a brief discussion on the fate and transport mechanisms of dioxin, particularly focusing on their movement through soil.[15]

4. As discussed earlier, the WDOE paper should have a well-defined objective. This should help clarify the need for, or the extraneousness of discussion of, reservoir sources. If discussing reservoir sources is deemed necessary, provide a brief discussion of the basis of the reservoir sources assessment.[16]

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[11] EPA, 1994a.
[12] EPA, 1995a.
[13] EPA, 1994a.
[14] EPA, 1995a.
[15] Once dioxins enter the soil, because of their very low water solubility and vapor pressure, they tend to become strongly adsorbed to soils, especially those with a high organic carbon content, and show little upward or downward migration (EPA, 1994a). After exposure to groundwater, the dioxin will generally move in the direction of the groundwater, although at a slower velocity than the groundwater itself, primarily due to the dioxins being strongly adsorbed to the soil (EPA, 1993).
[16] The Dioxin Reassessment documents utilized a simplified assessment, based on the assumptions of first-order degradation rates and a dioxin half-life of 10 years in the "reservoir" (i.e., soil and surface vegetation), to estimate the relative contribution of reservoir sources of dioxins compared to annual deposition rates. This simplified analysis suggests that reservoir sources may be responsible for 15 or more times the amount of dioxin released into the atmosphere on an annual basis. In addition, according to EPA's assessment, the factor of 15 times is probably a low end, and not a high end, estimate as the WDOE draft implies. There however remains a lot of uncertainty pertaining to reservoir sources, particularly in the assumptions made and the paucity of useful information necessary for the analyses of them, and thus further evaluation is necessary (EPA, 1995a).

- The two largest sources of CDD/Fs appear to be medical waste incinerators and municipal waste incinerators. Tire incineration may also be a source.

Comments:

1. The EPA Dioxin Reassessment documents present data in Table 3-2 and Figure 3-1 that indicate that medical waste incinerators and municipal incinerators are the largest emitters of dioxins for the sources for which data are available. There are other dioxin sources (e.g., industrial/municipal processes, chemical manufacturing/processing sources, etc.) for which data are not available.

2. The EPA's "confidence level" in the dioxin air emission data for medical and municipal waste incinerators is completely neglected.[17] This is a significant omission because the emission factor estimates used in the calculation of source emission estimates are of low (medical waste incineration) and medium (municipal waste incineration) EPA confidence levels.

3. Several other important sources of dioxin emissions in addition to medical and municipal waste incinerators are discussed in EPA's Dioxin Reassessment documents.

Suggestions:

1. The author should modify his comment, either to clarify that only sources for which data are available are considered, or to incorporate information about unquantified sources.

2. Include a brief discussion of pertinent EPA confidence levels for all data referenced.

3. Provide a brief discussion and/or table comparing the annual air emission rates of various sources of dioxins. A table listing comparable dioxin TEQ air emissions that we have put together is shown below.

[17] The EPA (1994a) developed a confidence rating scheme for the air emission data it presents in its Dioxin Reassessment documents. Criteria included the basis of the estimates (i.e., expert judgment, detailed studies, or direct emission measurements) and citation quality (i.e., peer-reviewed journals, draft reports, or personal communication). These criteria were then used to assign to the data either a "high," "medium," or "low" confidence rating.

Table Δ-1. Annual Emission Rates of TEQ Dioxins/Furans of Different Sources

Emission Source	2,3,7,8-TCDD TEQ low[a] g/yr	median or midrange[a] g/yr	mean g/yr	high[a] g/yr	Number of Tests
Typical Municipal Waste Incinerator[b]	7.60	17.54	N/A	39.18	30
Secondary Copper Smelter[b]	3.08	9.58	N/A	30.83	1
Various Cement Kilns[b]	0.52	1.65	N/A	5.22	57
Comparable Cement Kilns[b]	0.25	0.79	N/A	2.49	5
Typical Medical Waste Incinerator[b]	0.24	0.76	N/A	2.39	6
Holnam Seattle[c]	0.22	0.33	0.34	0.46	4
Typical Hazardous Waste Incinerator[b]	0.06	0.18	N/A	0.58	6
King County Registered Cars and Trucks[b,d]	0.03	0.17	1.13	4.05	10
Typical Sewage Sludge Incinerator[b]	0.05	0.12	N/A	0.26	3

[a] When possible, median estimates were used, however, EPA (1994a) only provided midrange estimates; low and high values are observed for non-EPA references, estimated for EPA.
[b] EPA, 1994a. Number of tests for fixed facilities refers to number of facilities tested. More precise information was not available. Number of tests for cars and trucks refers to a combination of individual vehicle tests and aggregate tunnel tests for unleaded and diesel vehicles. Calculated amounts reflect the ratio of gasoline and diesel vehicles in King County.
[c] AMTEST: 1996b; low and high figures are laboratory-reported rates and assume continuous operation; median and mean figures are based on stack concentrations and assume continuous operation and an average stack flow rate of 2125 dscm/min.
[d] WDOT, 1995; Lince, 1996.

- Cement kilns, especially those burning hazardous waste, appear to be the third largest source of CDD/Fs. Cement kilns in the United States are estimated to discharge dioxins and furans to air at a rate of 350 grams TEQ/year.

Comments:

1. This statement, as is, is inaccurate. Please refer to our comment #1 on the preceding WDOE statement (see page 9).

2. Again, the issue of the "confidence level" in the dioxin air emission data is not discussed. The emission factor estimates (i.e., the amount of dioxins produced per mass of material combusted/processed) that are used in the calculation of source emission estimates are of a low confidence level. This suggests that the 350 g TEQ/yr annual emission estimate for cement kilns is also of low confidence, primarily because the figure is based on limited data.

3. The 350 g TEQ/yr estimate for cement kilns was generated using assumptions that need to be discussed in the WDOE paper. In addition to the confidence level issue mentioned above, the 350 g TEQ/yr estimate is a sum of the emissions from hazardous waste-burning and non-hazardous waste-burning cement kilns. The contribution made to the annual TEQ emission estimate by cement kilns not burning hazardous waste (like the HOLNAM facility) is only 40% of the 350 g TEQ/yr value, that is, 140 g TEQ/yr.[18]

According to data presented in Table 3-2 and Figure 3-1 of EPA's Dioxin Reassessment documents, the central estimate for cement kilns' annual TEQ emission rate (350 g TEQ/yr) represents only 6.9% of the central estimate of the highest dioxin emitter - medical waste incinerators (5100 g TEQ/yr) - and 11.7% of the central estimate of the second highest dioxin emitter - municipal waste incinerators (3000 g TEQ/yr). If we consider the 140 g TEQ/yr value for only the non-hazardous waste-burning cement kilns mentioned in the previous paragraph, these percentages drop.

Using EPA's central estimates of available data, cement kilns as a whole generate only 3.8% of dioxins from anthropogenic sources, and non-hazardous cement kilns generate only 1.5%. These points are ignored in the WDOE paper.

<u>Suggestions:</u>

1. Data gaps should be discussed and statements should be modified to reflect inclusion or exclusion of unquantified sources of dioxins.

2. Include a brief discussion of the EPA's confidence levels associated with the referenced data.

3. Include appropriate information in the WDOE final document about the relative importance of cement kiln generation of dioxins, because cement kilns are a distant third largest source of dioxin TEQ among quantified sources.

- Cement kiln dust (CKD), the fine dust collected in air pollution control devices on cement kiln stacks, is estimated to account for about 24 grams TEQ/year.

<u>Comments:</u>

1. The characteristics of the source (i.e., source type, effectiveness of APCDs, etc.) and the location of the source of dioxins both play primary roles in determining the potential routes of human exposure. To assess possible adverse health effects, exposure to dioxins in air and to dioxins in CKD must be considered separately. Hence, it is incorrect to assume that a given amount of

[18] EPA, 1994a.

dioxins in CKD will have the same potential for human exposure (and therefore adverse health effects) as would the same amount in air emissions.

2. As with the air emissions data, the 24 g TEQ/yr estimate for CKD was generated using assumptions about sources and confidence levels that are not addressed in the WDOE paper, specifically:

- *The dioxin emission estimate that EPA calculates for CKD is actually 24.1 g TEQ/yr. Of that amount, 24 g TEQ/yr is attributed to CKD from cement kilns burning hazardous waste, while only 0.1 g TEQ/yr is from CKD produced at kilns not burning hazardous waste, such as HOLNAM.*

- *The emission factors used to calculate both the hazardous waste-burning and non-hazardous waste-burning kiln emission estimates were from data that were of "low confidence." This means that the annual emission estimates themselves also have a low confidence rating.*

3. The author does not make comparisons to other comparable materials listed in the EPA document:

- *According to data presented in Table 3-2 and Figure 3-1 of EPA's Dioxin Reassessment documents, the central estimate for CKD's annual TEQ generation rate (24.1 g TEQ/yr) is approximately 1.3% of the central estimate of the TEQ generation rate for municipal waste incinerator (MWI) fly and bottom ash (1800 g TEQ/yr), probably the most appropriate comparative materials to CKD listed in these EPA documents.*

- *If we consider only the non-hazardous waste-burning cement kilns (like HOLNAM) mentioned in the previous comment, the CKD TEQ generation rate constitutes only 0.01% of the MWI total ash TEQ generation rate.*

- *Furthermore, there are fewer MWIs (totaling 171) than there are cement kilns (totaling 212) in the U.S.[19] Therefore, as a percentage of the average MWI's total ash TEQ generation rate, the average kiln's CKD TEQ generation rate is smaller still than the percentages listed above.*

Once these points are addressed, a proper comparison can be made to the stack emissions of the HOLNAM facility (which does not use hazardous waste as a supplemental fuel source).

[19] EPA, 1994a.

4. The "potential risks" to humans were not developed based on EPA's estimate of dioxins in CKD and were not interpreted using risk-based guideline values.

Suggestions:

1. Provide discussion about the routes of exposure (e.g., inhalation, beef or milk ingestion, etc.) for air emissions and CKD and their implications for health impacts (i.e., specific health end-points) in the WDOE final paper. Furthermore, review of the characteristics and location of the source and the existence of other nearby dioxin sources will provide important insight into these issues.

2. As stated previously, incorporate a discussion of confidence levels described in the referenced EPA document.

3. Include comparison of annual CKD dioxin TEQ generation rates with that of comparable materials such as incinerator ash.

4. Incorporate some discussion on "potential risks" to humans resulting from this CKD dioxin source estimate into the final WDOE paper.

- The primary route by which dioxin-like chemicals enter the food chain is believed to be from atmospheric deposition:

> "This assessment proposes the hypothesis that the primary mechanism by which dioxin-like compounds enter the terrestrial food chain is via atmospheric deposition. Deposition can occur directly onto plant surfaces or onto the soil. Soil deposits can enter the food chain via direct ingestion (i.e., earthworms, fur preening by burrowing mammals, incidental ingestion by grazing animals, etc.). CDD/F in soil can become available to plants by volatilization and vapor absorption or particle resuspension and adherence to plant surfaces."

Comments:

1. The SAB has stated that "given the existing data, it is probably premature to conclude that the air-to-plant-to-animal pathway is the primary way the entire food chain is impacted" by dioxins, even though it is a reasonable hypothesis that is consistent with extant data and existing models.[20] There may be other potentially significant source pathways, such as the chemical released at a point source, moving through water, and eventually being stored in fish or exposures from cigarette smoking.

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[20] EPA, 1995a.

2. As mentioned before, use of the term "dioxin-like compounds" is not clear.

Suggestion:

Address and, as appropriate, incorporate into WDOE's final paper the more recent literature related to the principal routes of human exposure to dioxins.

CEMENT KILNS AS POTENTIAL SOURCES OF CDD/FS IN WASHINGTON STATE

The RAF summarized information for EPT (Ecology's Executive Policy Team) from each Ecology program on potential dioxin sources they might regulate. Sources that are likely to be significant but for which we have few, if any, data are:

- Air emissions from medical and municipal waste incinerators.
- Material collected in air pollution control devices (APCDs) from medical and municipal waste incinerators.
- Air emissions and disposal of ash generated by wood stoves and hog fuel boilers burning salty wood.
- Illegal (or accidental) burning of prohibited materials (plastics, roofing, wire insulation, penta-treated wood, etc.).
- *Air emissions from cement kilns.*
- *Cement kiln dust collected in APCDs.*

During the RAF review Hazardous Waste staff reported that CKD from the Holnam cement kiln (located southwest of the Duwamish Waterway in Seattle) was being applied to agricultural land as a "soil sweetener"; that is, to raise the pH of acid soils.

This material is given/sold? to Northern Lime in Burlington. They are said to have annual sales of 40,000 tons of CKD with 23,000 T used as soil amendment, 7000 T as soil stabilizer, and 10,000 T for waste solidification (Bob Stone, personal communication).

The use of CKD as a soil amendment on agricultural lands raises special concerns because it has the potential to provide a relatively direct route of human exposure as hypothesized by EPA (see above).

Comments:

1. There is little potential for dioxins to significantly leach or volatilize once they adsorb to particulate matter.[21] Using Toxicity Criteria Leaching Potential (TCLP)

[21] EPA, 1994a.

studies, dioxins have been shown to stay entrained in the CKD matrix and leach to a negligible degree.[22]

2. The bioavailability issue of dioxins within plants is not fully understood. The plant mechanisms that regulate the uptake and movement of available dioxin molecules through the roots and within the plant structure are complex. Most of the available studies concur that air-to-plant transfer is the primary route of dioxin uptake in plants (compared to soil-to-plant transfer) and preliminary results suggest that different vegetable, fruit, and crop plant types (e.g., cucumbers, lettuce, potatoes, apples, and pears) vary in their capacity to absorb dioxins adsorbed to soil or soil additives. For most samples analyzed, the outer portions of the crops (e.g., peel) showed higher dioxin concentrations than the inner portions (e.g., pulp). [23]

3. Several agricultural studies have shown that compared to potassium fertilizers, CKD is an inexpensive and acceptable alternative fertilizer. [24] *These studies have shown:*

- *Unlike most inexpensive potassium fertilizers, which tend to have an undesirably high chloride content, CKD essentially has no chloride.*
- *Crops grown in soil fertilized with CKD demonstrated desirable vegetable characteristics (i.e., higher starch content in potatoes, higher protein content in peas and oats, and higher sugar content in beets) resulted.*
- *Compared to potassium fertilizers, CKD use produced similar crop yields.*

There are fewer studies on CKD as a liming agent, although most have shown favorable results regarding CKD's ability to treat acidic soils.[25]

Suggestions:

1. These facts should be addressed in the WDOE's assessment of CKD usage.

2. Providing a brief discussion and/or table comparing the dioxin concentrations in CKD to dioxin concentrations in other soil additives would give some additional perspective. The table shown below lists comparable dioxin concentrations that we have put together.

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[22] EPA, 1993.
[23] Hülster and Marschner, 1993; Hülster et al., 1993; Hülster et al., 1994; Müller et al., 1994.
[24] EPA, 1993.
[25] EPA, 1993.

Table Δ-2. Dioxin Concentrations in Various Soil Additives

Dioxin Matrix	2,3,7,8-TCDD TEQ Concentration [pg/g]	References
Herbicides		
2,4,5-T	up to 20,000	ATSDR, 1989[a]
2,4-D	234	Klyuev, 1991
Germicide		
Hexachlorophene	200 - 500	ATSDR, 1989[b]
Sewage Sludge	34 -38	McLachlan, 1994
Liming Agent (Dolime)	2.7[c]	TLI, 1996
Fertilizer		
NPK-16-16-16-S	2.4[c]	TLI, 1996
Holnam CKD	1.5[c]	TLI, 1996
Manure	0.002	Fries, 1995; Stevens and Gerbec, 1988; Schmitt and Rehm, 1992

[a] This value represents the level of 2,3,7,8-TCDD that was found in most commercially available 2,4,5-T mixtures before it was completely banned in 1979.
[b] This value represents the level of 2,3,7,8-TCDD found in this germicide which was manufactured from trichlorophenol.
[c] These values assume non-detects were at the detection limit.

3. Since the rate of application of these materials will impact the amount of dioxins that could come into contact with the soil, provide a brief discussion about the application processes of the various soil additives. An analysis for CKD and cow manure application yielded dioxin "application" rates of 10.2 μg/hectare (TEQ) and 0.45 μg/hectare (2,3,7,8-TCDD) for CKD and manure, respectively.[26] In interpreting this information, it is important to keep three points in mind:

- ***The potential for dioxins to leach out of the CKD matrix is low.[27]***
- ***CKD can act as a fertilizer <u>and</u> a liming agent, while manure is only used as a fertilizer.[28]***
- ***Even "natural" fertilizers like cow manure have low concentrations of dioxins.***

TDF (tire-derived fuel) and "Sterifuel" (a shredded, sterilized medical waste) augment the fuel used in the Holnam kiln. Although EPA's draft reassessment points to the practice of burning hazardous waste in cement kilns as having a particularly *high potential* for generating dioxin/furan, studies done so far seem not to have specifically evaluated

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[26] The following information was obtained from a number of articles:

<u>CKD application</u>

Holnam CKD dioxin concentration: 1.51 ng/kg (TLI, 1996)
CKD application rate: 1-3 tons/acre = 2246 - 6739 kg/hectare (Northern Lime, 1996)

→ Dioxin "application" rate for high-end CKD use:

(1.51 ng/kg)(6739 kg/hectare) = 10176 ng/hectare or <u>10.2 μg/hectare</u>

<u>Cow manure application</u>

Amount of bovine daily TCDD intake via food and soil ingestion: 127 pg/day (Stevens and Gerbec, 1988; TCDD was assumed to refer to 2,3,7,8-TCDD)
Amount of daily TCDD intake excreted in feces: 75% (based on an excretion percentage given in Fries (1995) for 2,3,7,8-TCDD)
Amount of feces that a 1400-lb cow excretes in a day: 112 lbs/day = 50.9 kg/day (Schmitt and Rehm, 1992)
Manure application rate: 5 lbs/ft^2 = 244,545 kg/hectare (Steer Co Compost, 1996)

→ Dioxin "application" rate for cow manure:

$$\frac{(127\,pg/day)\cdot(0.75)}{50.9\,kg/day}\cdot(244{,}545\,kg/hectare) = 457{,}621 \text{ pg/hectare or } \underline{0.45\ \mu g/hectare}$$

[27] EPA, 1993.
[28] Therefore, if a liming agent is necessary, using a commercially available liming agent like dolime will likely result in a higher dioxin "application" rate for the manure-dolime tandem than the level for CKD.

facilities that burn wastes (like medical waste and tires) which, although they are not federally designated as "hazardous waste", have been shown to generate CDD/Fs when burned *[sic]*.

Comments:

1. It is unclear what the author is saying here. Subsequent comments refer to points believed to have been made.

2. As stated earlier, HOLNAM does not burn any hazardous or medical waste as a supplementary fuel source. Sterifuel® has only been used by HOLNAM in test burns. It is not currently being used as a supplemental fuel.

3. We disagree with the assessment that the EPA Dioxin Reassessment documents point to cement kilns as having a high potential for generating dioxins. Studies done on cement kilns have been quite minimal. Stack emission data presented in these documents represent only 17 of 212 cement kilns.[29] Furthermore, the annual emission rate estimate of 350 g TEQ/yr for all cement kilns is far below the annual estimates for the largest emitters of dioxin - medical and municipal waste incinerators (5100 and 3000 g TEQ/yr, respectively).

4. There is some information presented in the EPA Dioxin Reassessment documents about source emissions from a tire combustion facility. Based on a single facility's stack test data, tire combustion used solely as a source of power/energy generation appears to have a low potential for being a major contributor to TEQ air concentrations.

Suggestions:

1. Clarify or correct the context for the statement regarding the "...high potential for generating dioxins/furans..."

2. See our previous comments regarding the fuel sources HOLNAM uses in its kiln.

3. Qualify or remove the assessment that hazardous waste-burning cement kilns have a high potential for generating dioxins.

Staff at King County Solid Waste and the Hazardous Waste Program at NWRO report that although CKD classifies as a Washington State hazardous waste (based on its high alkalinity), Holnam CKD is the subject of a one-year waiver from normal requirements for handling hazardous wastes. This waiver allows the CKD to be land-applied.

[29] EPA, 1994a.

<u>*Comments:*</u>

1. Washington State's classification of CKD as a special waste is based on its highly alkaline nature, resulting in a pH ranging between 12.5 and 12.9 when tested according to Washington state-only criteria. It is of interest to note that even though the pH of cement is approximately 13.0, it is not considered a hazardous material.

2. CKD is not designated as a hazardous waste. Explaining that CKD is a special waste because of its pH level is informative. This point, taken together with the facts of the higher pH of cement and of cement not being classified as a hazard, adds perspective to CKD's waste classification.

<u>*Suggestion:*</u>

Provide a description of the basis for CKD's special waste classification and compare CKD's hazard to that of cement.

Evidently, concern about potential CDD/F contamination has not been raised previously, and neither King County nor Ecology have CDD/F data for Holnam's CKD.

<u>*Comment:*</u>

It is our understanding that WDOE now has the laboratory analysis on dioxin in HOLNAM'S CKD.

<u>*Suggestion:*</u>

Include the laboratory analyses on dioxin in HOLNAM'S CKD. The risk of adverse health effects can be estimated with these data.

There is also a second cement kiln operating on the Duwamish tide flats. This company is called Ash Grove Cement. I have not inquired into their practices.

<u>*Comments:*</u>

1. We have not reviewed any data for the Ash Grove Cement Company.

2. WDOE's focus on HOLNAM'S kiln in light of the knowledge of a second cement kiln proximate to it requires more explanation than that provided.

<u>*Suggestion:*</u>

Broaden the final WDOE paper to evaluate other comparable and nearby dioxin sources.

AIR EMISSIONS/SOURCE TEST DATA

Puget Sound Air Pollution Control Authority (PSAPCA) to find out if they had relevant information *[sic]*. They have results from source testing of air emissions at Holnam conducted in 1994 and 1995 (AMTEST, 1994, 1995, 1996a).

Table 1 shows the results of these tests. Three sets of results are shown. The first set was conducted in 1994 under "normal fuel conditions". The second two sets were conducted in 1995 under two fuel conditions (Condition 1 - "Sterifuel Off", Condition 2 - "Sterifuel On"). Further details on operating conditions at the kiln are said to be available in the appendices of the source test reports and have been requested.

Comments:

The three errors that were found in Table 1 are listed below and are also presented in bold, italic print in parentheses in Table 1.

- ***Review of the 1995 AMTEST data indicated that the "Sterifuel® Off" emission rate for 2,3,7,8-TCDF should be 2597 ng/min, and not 2622 ng/min. If the 2622 ng/min value was the result of an adjustment made for the possible contributions from other TCDF isomers, an explanation should be included.***

- ***Review of the 1995 AMTEST data indicated that the "Sterifuel® On" emission rate for 2,3,7,8-TCDF should be 6112 ng/min, and not 6131 ng/min. If the 6131 ng/min value was the result of an adjustment made for the possible contributions from other TCDF isomers, an explanation should be included.***

- ***The mass emission rate should be in terms of [mg TEQ/day] and not just [mg/day].***

Suggestions:

These data should be explained, or if incorrect, should be corrected.

Table 1. Emission Rates[a] Measured for Cement Kiln Stack (HOLNAM, INC.)

	Emission Test (May 26-27, 1994)	Emission Test (July 24-28, 1995)	
(Units = ng/min)	"Normal"	"Sterifuel Off"	"Sterifuel On"
2,3,7,8-TCDF	1352	2622 *(2597)*	6131 *(6112)*
2,3,7,8-TCDD	86.3	157.0	353.9
1,2,3,7,8-PeCDF	ND[b]	230.6	ND
2,3,4,7,8-PeCDF	392.6	622.8	1724
1,2,3,7,8-PeCDD	~73	ND	164.7
1,2,3,4,7,8-HxCDF	139.5	ND	ND
1,2,3,6,7,8-HxCDF	49.4	ND	187.3
2,3,4,6,7,8-HxCDF	~75.1	~82.2	282.9
1,2,3,7,8,9-HxCDF	ND	ND	ND
1,2,3,4,7,8-HxCDD	51.1	ND	ND
1,2,3,6,7,8-HxCDD	125.2	ND	206.3
1,2,3,7,8,9-HxCDD	88.6	ND	126.0
1,2,3,4,6,7,8-HpCDF	~71.6	~155.1	370.5
1,2,3,4,7,8,9-HpCDF	ND	ND	ND
1,2,3,4,6,7,8-HpCDD	889.6	351.4	706.4
OCDF	139.8	ND	ND
OCDD	3158	571.4	960.9
TEQ	448.7	794.6	2005
Mass Emission [mg *TEQ*/day]	0.65	1.14	2.89

[a] Source: AMTEST, 1994, 1995, and 1996a;
[b] ND = not detected.

Table 2 summarizes the mass emission rates measured by AMTEST during each of the source tests. The results are given as TCDD toxicity equivalents (TEQ) in milligrams per day (mg/d):

Table 2. Mass Air Emission Rates for CDD/F (in mg TEQ/d) from the HOLNAM Cement Kiln Stack

Year	Fuel Condition[a]	Mass Emission [mg TEQ/d]	Mass Emission [g TEQ/yr]
1994	"Normal"	0.65 mg/d	0.24 g/yr
1995	"Sterifuel Off"	1.14 mg/d	0.42 g/yr
1995	"Sterifuel On"	2.89 mg/d	1.06 g/yr

[a] Fuel condition as reported in text of source test reports (AMTEST, 1994, 1995) – more information may be available in appendices of test reports.

Comments:

1. PSAPCA has provided HOLNAM with a letter that explains HOLNAM'S compliance with state air guidelines. There is no mention of this letter or of HOLNAM'S compliance in the WDOE document.

2. HOLNAM has collected a 1996 set of stack emission samples and analyzed them for dioxins. Results show acceptable and decreased dioxin TEQ emissions.

3. We estimated the ground-level concentration using a conservative screening air dispersion model and stack emission rates.[30] The estimated ground-level concentration was compared to EPA's RBC and WDOE's ASIL guideline values; no adverse health effects are expected.

- ***Estimated ambient ground-level 2,3,7,8-TCDD TEQ concentration for 1995 was 5.0 x 10^{-9} µg/m^3, and for 1996 the concentration was 2.8 x 10^{-9} µg/m^3 (see Figure A-1).[31] For 1995, this worst-case value is only 10% of EPA's RBC of 5 x 10^{-8} µg/m^3 and 17% of WDOE's more stringent ASIL of 3.0 x 10^{-8} µg/m^3. For 1996, this worst-case value is only 6% of EPA's RBC and 9% of WDOE's ASIL.***
- ***Estimated ambient ground-level 2,3,7,8-TCDD TEQ concentration supplemented with Sterifuel® was estimated for 1995 and 1996. For 1995, the estimated ambient air 2,3,7,8-TCDD TEQ concentration of 1.2 x 10^{-8} µg/m^3 was 24% and 40% of EPA's RBC and WDOE's ASIL, respectively. For 1996, the estimated ambient air 2,3,7,8-TCDD TEQ concentration of 2.8 x 10^{-9} µg/m^3 was 6% and 9% of EPA's RBC and WDOE's ASIL, respectively.***

[30] TRC Environmental Consultants, 1991. To estimate the worst-case exposure scenario, the highest modeled annual ground-level concentration was used. This value [µg/m^3 / g/sec] was multiplied by the measured emission rate [g/sec] to yield the actual annual ground-level concentration estimate [µg/m^3]. The CTSCREEN yielded the highest modeled annual ground-level concentration estimate of 0.38 µg/m^3 / g/sec).

[31] AMTEST, 1996b.

- *In the 1996 stack emission data, the "Sterifuel® On" and "Sterifuel® Off" conditions show: (1) dioxin emissions below the baseline values for the HOLNAM facility,[32] and (2) no statistical difference (p=0.89) between the two conditions.[33] Additionally, analysis of the "snap-shot" of data referenced in WDOE's paper indicates that the "Sterifuel® On" and "Sterifuel® Off" mean values are not statistically significantly different (p=0.064).[34] When the 1995 and 1996 data are analyzed together, the probability is reasonably high (p=0.098) that the observed difference between the two conditions is a result of random variation.[35]*

The results of the statistical analyses presented above should be interpreted with two issues kept in mind: (1) the sample sizes for each sample group were small (5 or less cases), and (2) high variability was seen within sample groups. These factors will reduce the statistical power of the tests used to analyze the data and upon which conclusions are based.

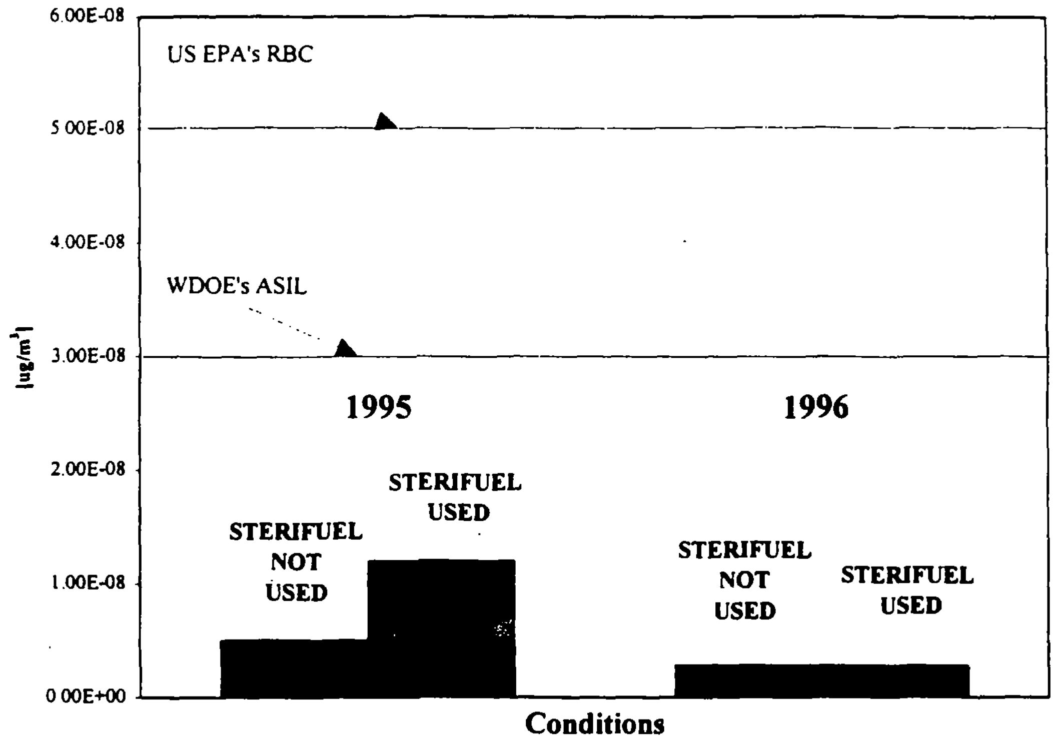
[32] Baseline conditions refer to runs conducted prior to "Sterifuel® On" stack tests.

[33] Using paired t-test, 2 cases. In this and subsequent t-test statistical analyses, normality is assumed.

[34] Using paired t-test, 3 cases.

[35] Using paired t-test, 5 cases. DELTA also analyzed these data using an unpaired, two-sample t-test not assuming equal variances. This resulted in less statistical power (p>0.1). DELTA also analyzed all available 1994 through 1996 HOLNAM dioxin TEQ emission rate data in this manner. Results were similar (p>0.1). Assuming equal variances would likely result in a statistically significant difference between sample means, but inspection of data plots indicates that assuming homoscedasticity is currently a questionable assumption. Based on this, we chose to use the separate variance t-test. Additionally, identification of a significant difference in the means requires heavy reliance on one set of samples (1995 "With Sterifuel®/ Sterifuel® On"). Another sampling event or two will likely provide greater confidence with which to reject (or again not to reject) the null hypothesis that the two conditions have equal means.

Figure Δ-1: The Estimated Ground-level Concentration for 2,3,7,8-TCDD TEQ Concentration for both Sterifuel® Use and Non-Use



Suggestions:

1. Include a copy of the PSAPCA letter for additional information on the HOLNAM facility as a source of dioxin air emissions.

2. Review the 1996 set of stack emission data, which are now available. A discussion of these data and the estimated ground-level concentrations included above would provide additional perspective on the HOLNAM facility as a source of dioxin air emissions.

3. Update WDOE paper with recent data and apply simple statistical analyses to provide basis for comments.

WHAT DO THESE RESULTS MEAN?

Placing these emissions in perspective is not a straightforward task. Unfortunately, we have no information on the total amount of CDD/Fs discharged in Washington state. There is some information on wastewater discharges from pulp mills, but almost none for potentially major sources like municipal and medical waste incineration. Quantifying these sources would require source testing air emissions and quantifying CDD/Fs in fly ash generated during the incineration.

<u>*Comments:*</u>

Comparisons of dioxin releases into different media from different source types cannot be made readily. The WDOE paper compares the emission of dioxins (from the stack of a combustion facility) into air with the release of dioxins (from paper and pulp mills) into water. There is a great body of literature that discusses the differences between the environmental fate and transport of dioxins in air and in water and the significant impact these processes have on human exposure.

<u>*Suggestion:*</u>

Make appropriate comparisons to provide meaningful information. For example, compare HOLNAM stack emission rates of dioxins to appropriate air standards and/or to emissions of other combustion sources (such as automobile exhaust, municipal and medical waste incinerators, and other cement kilns) (see Table Δ-1).

In the next section of this document, I compare the CDD/F mass emission rates (in mg TEQ/d) measured at Holnam to several other measures of emission or "loading." Hopefully, this will help us begin to get a sense of the relative importance of various CDD/F sources.

<u>*Comment:*</u>

Determining annual dioxin-loading estimates for various sources does not provide information on human exposure. It would be more meaningful to know the dioxin emissions and/or resulting air concentrations in a localized area and then compare these to health-related guideline values. Simply relying on dioxin-loading estimates is less helpful in analyzing risk, because the environmental fate and transport of dioxins affects the amount of dioxins available for human exposure.

<u>*Suggestions:*</u>

1. Stack emissions from the HOLNAM facility should be compared to other dioxin air combustion emitters. An example of some comparative emissions data is shown in Table Δ-1.

2. Whether evaluating chemical exposures from air emissions or CKD usage, there are four primary factors that need to be assessed and discussed to determine human exposure. They are:

- ***Characteristics of the sources of dioxins;***
- ***Location of the emission sources;***
- ***Location of receptors; and***
- ***Routes of human exposure.***

First, Table 3 compares Holnam's emission rates to wastewater discharges from three pulp mills tested between 1989 and 1993.

Comment:

Direct comparisons of dioxin releases into different media from different source types should not be made when characterizing potential adverse health effects.

Suggestion:

As noted before, stack emissions from the HOLNAM facility should be compared to other combustion facilities or sources emitting dioxins into the air.

The first of these, the Celgar mill, is located in British Columbia and discharges to the Columbia River. In 1989, the mill was using old chlorine bleaching technology with little or no wastewater treatment. In 1989, when CDD/F loading to the Columbia was 3 mg

Table 3.
Dioxin/Furan Loads from Several Industrial Facilities
[mg TEQ/day]

Year/ Facility Name	1995 Holnam	1995 Holnam	1989 Celgar	1992 Celgar	1993 Celgar	1992 Boise Cascade	1991 Weyerhaeuser
Location	Seattle, WA	Seattle, WA	British Columbia	British Columbia	British Columbia	Wallula, WA	Cosmopolis, WA
Type	Cement kiln	Cement kiln	Pulp mill	Pulp mill	Pulp mill	Pulp mill	Pulp mill
Emission	Air	Air	Water	Water	Water	Water	Water
Conditions	Without medical waste	With medical waste		With process change	With process change		
Load [mg/day]	1.14	2.89	3.0	1.0	<0.2	~0.6	~0.2
Data Source	(1)	(1)	(2)	(2)	(2)	(3)	(4)

Data Sources:

1. AMTEST Inc., 1995. Holnam Inc. Main Cement Kiln Stack. Seattle, Washington, July 24-28, 1995.

2. Serdar, D., B. Yake, and J. Cubbage, 1994. Contaminant Trends in Lake Roosevelt, 32 pp. + appendices.

3. Johnson, A. and M. Heffner, 1993. Class II Inspection of the Boise Cascade Pulp & Paper Mill, Wallula, Washington, April 1992, 29 pp. + appendices.

4. Golding, S. and M. Heffner, 1992. Weyerhaeuser Paper Company (Cosmopolis Plant) May 1991 Class II Inspection, 39 pp. + appendices.

TEQ/d, the mill was responsible for the CDD/F contamination of Lake Roosevelt fish which led, in turn, to a fish consumption advisory.

By 1993, the mill had completely upgraded its bleaching technology and installed secondary treatment. The CDD/F load to the Columbia had fallen to less than 0.2 mg TEQ/d and levels in Lake Roosevelt fish tissue had fallen substantially (Serdar, Yake, and Cubbage, 1994).

The second comparison (Table 4) presents loading capacities for TCDD at various locations on the Columbia River system (EPA, 1991). These "loading capacities" were determined by EPA for their Columbia River Dioxin Waste Load Allocation and are the total amounts of TCDD the river would be allowed to carry (at a specific point) without exceeding the water quality criterion. These values vary as a function of river flow – a larger river will carry a larger contaminant load than a smaller river if the contaminant concentrations are equal.

This comparison is complicated by the fact that EPA only addresses TCDD in this total maximum daily load (TMDL) determination. However, if one accepts the assumptions associated with the determination of toxic equivalents (e.g., 1 g 2,3,7,8-TCDD = g TEQ *[sic]*, 10 g 2,3,7,8-TCDF = 1 g TEQ, etc.) then this comparison shows that the amount of dioxin-like chemicals discharged from the Holnam facility (0.65-2.89 mg TEQ/d) is in the same range as the total dioxin load (0.54-5.97 mg TEQ/d) permitted for the Columbia River.

Table 4. Loading Capacity for 2,3,7,8-TCDD at Various Locations in the Columbia River

Location	Loading Capacity [mg TCDD/d]
Columbia River at International Border	2.31
Columbia River at McNary Dam	4.54
Snake River near Mouth	1.18
Willamette River near Mouth	0.54
Columbia River near Mouth	5.97

Comment:

As noted before, this comparison is an inappropriate one.

Suggestion:

Stack emissions from the HOLNAM facility should be compared to those from other facilities releasing dioxins into the air, and discharges of dioxins from pulp and paper mills should be compared to those of other facilities releasing dioxins into the water.

A third way of putting these emissions in perspective is to compare them to EPA's national estimate of air discharges of CDD/F from cement kilns; 350 g TEQ/yr (960 mg TEQ/d). The source test results from Holnam shown in Table 2 give emission rates that range between 0.1% and 0.3% of the total national load estimated for cement kilns.

Comment:

We are not sure of the intention of this point since:

1. 0.1% and 0.3% are very small values compared to the total national "load" estimated for cement kilns. The 0.3% value is also based on 1995 "Sterifuel® On" emission data which is of interest because: (a) Sterifuel® is not currently used as a supplemental fuel at HOLNAM, and (b) the 1995 Sterifuel® value may be high due only to data variability. The 1995 "Sterifuel® On" dioxin emission rate is more than four times higher than the 1996 value. Furthermore, using values from the EPA Dioxin Reassessment documents, the estimated average emission rate for a non-hazardous waste-burning cement kiln (0.8 g TEQ/yr) would represent approximately 0.2% of the total national "load," which is at least two times higher than the amount that is attributable to HOLNAM based on 1996 emission data (range of 0.06% to 0.1% of the national "load;" see Table Δ-1).

2. The percent of total national "load" gives no useful information needed to determine human exposures.

With any of these comparisons, Holnam's CDD/F stack emissions appear to be significant. Concern about the stack emissions is heightened by two additional aspects of this situation:

Comment:

Again, the comparisons provided in the WDOE document are inappropriate. Thus the use of the term "significant" here, in either a statistical or non-statistical manner, is also inappropriate.

-- The kiln is located immediately upwind of the most densely populated urban area in the state.

Comment:

This comment is misleading since it assumes that an unacceptable health risk is associated with HOLNAM dioxin stack emissions. Based on the information we have reviewed, dioxin emissions from the HOLNAM facility are not expected to cause adverse health effects to individuals living or working in the area around the plant.

Suggestion:

Remove or clarify the statement.

-- A second cement kiln (Ash Grove) is located in the same area.

Comment:

We have not reviewed the data for the Ash Grove facility and cannot comment.

SPECIAL CONCERNS ABOUT CEMENT KILN DUST

A comprehensive report to Congress (EPA, 1993) on CKD begins its evaluation of agricultural liming as follows:

"Because of the potential for bioaccumulation and the direct ingestion of contaminated food products, CKD used as a liming agent appears, on first evaluation, to pose more of a potential risk than any other CKD use."

Based on this evaluation, EPA concludes:

"Preliminary evaluation identified two types of uses that could have a greater potential to pose risk to human health and the environment: agricultural liming and construction of unpaved roads and parking lots."

Comments:

1. The referenced risks are not qualified or quantified. Presenting information in this manner is not useful.

2. Further evaluation of the referenced document[36] indicates:

- ***EPA's 1993 high-end risk estimate for dioxins in the liming agent scenario was 1.25×10^{-5}.[37] This risk estimate is consistent with the EPA policy of selecting risk management targets between 1×10^{-4} and 1×10^{-6}.[38]***

- ***EPA's predicted risk estimate for dioxins using CKD in the construction of unpaved roads and parking lots was $\leq 1 \times 10^{-7}$.***

3. Due to their highly insoluble nature, dioxins have been shown in TCLP studies to stay bound in the CKD matrix and to leach to a negligible degree.[39] Even if minute quantities made their way into the soil, the dioxin molecules would likely bind strongly to the soil particles, especially if the soil particles have a high organic carbon content, and would not be readily absorbed through plant roots.

Suggestions:

1. In order for risks to be discussed, a qualitative explanation of, or quantitative estimates of, the risk should be provided.

2. A better assessment of risk associated with CKD land application would include a discussion on:

- ***EPA's qualitative risk assessment;***
- ***EPA's quantitative risk estimates;***
- ***Leaching potential of dioxins in CKD;***
- ***Dioxin movement in soil; and***
- ***Uptake of dioxins by plant roots.***

It is important to recall that "reservoir sources" may be responsible for much of the ongoing exposure to CDD/Fs (see Background, above). Relatively uncontrolled

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[36] EPA, 1993.
[37] Risk estimates were generated for a hypothetical subsistence farmer scenario in which ingestion of vegetables from the field, and beef and milk raised on feed from the field were assumed. The high-end risk characterization incorporated a number of highly conservative assumptions. First, a high-end CKD application rate and high-end CKD concentrations corresponding to the highest risk potential waste stream from five baseline facilities were assumed. Second, the subsistence farmer scenario incorporates extremely conservative exposure assumptions and is used primarily to provide a worst-case farmer scenario. These assumptions include obtaining all vegetables, beef, and milk from the same home-grown source everyday for 70 years. The dioxin concentration in the CKD used as a soil additive was also assumed to stay at the high-end estimate for the entire 70-year period. The likelihood that this type of subsistence farming scenario actually occurs is quite minimal.
[38] 55 FR 8716, March 9, 1990.
[39] EPA, 1993.

applications (like the ones highlighted by EPA in the preceding paragraph) raise additional concerns about augmenting these sources.

Comment:

See the earlier comments regarding the issue of reservoir sources. These statements in effect "double count" CKD TEQ generation rates by confusing generation of dioxins with transfers between different environmental compartments.

Suggestion:

See the earlier suggestions regarding reservoir sources, and provide a clear distinction between the generation of dioxins and the transfer between environmental compartments.

Given this information and the significant presence of CDD/Fs in Holnam's kiln stack emissions, concerns about the potential for CDD/F contamination of CKD seem justified.

Comments:

1. The information presented is unsubstantiated and has been refuted in the above comments.

2. We do not understand what is meant by "significant," especially when the average kiln in EPA's Dioxin Reassessment documents releases 1.65 g TEQ/yr and HOLNAM only releases 0.18 - 0.46 g TEQ/yr.[40]

3. CKD contains trace amounts of dioxins; however, the author has failed to provide the rationale (namely the information or the scientific analysis) for proposing possible health concerns related to the trace dioxin content of CKD and/or CKD usage.

Suggestions:

1. The issues of the potential health risks associated with CKD land application need to be addressed, per the above comments.

2. Remove the incorrect assessment that HOLNAM has significant stack dioxin emissions.

3. Provide a calculation of the lifetime risk from ingestion of HOLNAM CKD.[41]

[40] AMTEST, 1996b.

[41] Using the standard soil ingestion pathway risk equation shown below (EPA, 1989) and assuming standard exposure assumptions for a reasonably maximum exposed individual (MEI) for the soil ingestion

RECOMMENDATIONS

Based on the information presented in this paper, I recommend the following:

1) Take necessary steps through discussions with Holnam and a review of regulatory options to temporarily suspend the land application of Holnam CKD.

Comment:

We strongly disagree. Much of the information provided in our responses demonstrate that the use of HOLNAM CKD does not present a human health hazard. The key issues illustrating this point are:

1. Due to their highly insoluble nature, dioxins have been shown in TCLP studies to stay bound in the CKD matrix and to leach to a negligible degree.[42] Even if minute

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pathway (i.e., ingestion rate of 100 mg/day, fraction ingested from the contaminated source of 1.0, exposure frequency of 350 days/yr, exposure duration of 70 years, and a body weight of 70 kg), we get:

$$\text{Intake [mg/kg-day]} = \frac{C_{CKD} \cdot IR \cdot CF \cdot FI \cdot EF \cdot ED}{BW \cdot AT}$$

where C_{CKD} = Chemical concentration in Holnam CKD [mg/kg]
IR = Ingestion Rate [mg soil/day]
CF = Conversion factor [10^{-6} kg/mg]
FI = Fraction ingested from contaminated source [unitless]
EF = Exposure frequency [days/yr]
ED = Exposure duration [yrs]
BW = Body weight [kg]
AT = Averaging time [days]

$$\text{Intake [mg/kg-day]} = \frac{1.5\text{x}10^{-6} \cdot 100 \cdot 10^{-6} \cdot 1.0 \cdot 350 \cdot 70}{70 \cdot 25550} = 2.1 \times 10^{-12} \text{ mg/kg-day}$$

Multiplying this intake value by the cancer slope factor for dioxin (i.e., 1.56×10^5 kg-day/mg), we get:

Excess Cancer Risk = $(2.1 \times 10^{-12})(1.56 \times 10^5)$
$= 3.2 \times 10^{-7}$
$\approx$ 3 chances per 10,000,000 of developing cancer above background levels

For perspective, background U.S. cancer mortality is approximately 0.25, so an actual excess lifetime risk of 3.2×10^{-7} would increase a person's (who is living under the above mentioned conditions) risk to about 0.25000032. Keep in mind that estimates of risk derived in this manner are not maximum likelihood (expected value) estimates applicable to the average person, but estimates of an upper bound risk (of statistically indeterminate range) to a hypothetical maximum reasonably exposed individual.

[42] EPA, 1993.

quantities made their way into the soil, the dioxin molecules would likely bind strongly to the soil particles, especially if the soil particles have a high organic carbon content, and would not be readily absorbed through plant roots.

2. The bioavailability issue of dioxins within plants is not fully understood. The plant mechanisms that regulate the uptake and movement of available dioxin molecules through the roots and within the plant structure are complex. Most of the available studies concur that air-to-plant transfer is the primary route of dioxin uptake in plants (compared to soil-to-plant transfer) and preliminary results suggest that different vegetable, fruit, and crop plant types (e.g., cucumbers, lettuce, potatoes, apples, and pears) vary in their capacity to absorb dioxins adsorbed to soil or soil additives. For most samples analyzed, the outer portions of the crops (e.g., peel) showed higher dioxin concentrations than the inner portions (e.g., pulp). [43]

3. Several agricultural studies have shown that compared to potassium fertilizers, CKD is an inexpensive and acceptable alternative fertilizer. [44] *These studies have shown:*

- *Unlike most inexpensive potassium fertilizers, which tend to have an undesirably high chloride content, CKD essentially has no chloride.*
- *Crops grown in soil fertilized with CKD demonstrated desirable vegetable characteristics (i.e., higher starch content in potatoes, higher protein content in peas and oats, and higher sugar content in beets) resulted.*
- *Compared to potassium fertilizers, CKD use produced similar crop yields.*

There are fewer studies on CKD as a liming agent, although most have shown favorable results regarding CKD's ability to treat acidic soils.[45]

3. Dioxin concentrations in CKD are similar to those in other soil additives (see Table Δ-2).

4. Not only does CKD offer the agricultural benefit of effectively serving as both a fertilizer and a liming agent, but it is also a byproduct of a common industry. Using CKD as an available resource in a beneficial manner is therefore a much better and cost-effective alternative to simply placing it in landfills.

5. Evaluating the health risk associated with the daily soil-like ingestion of CKD using the standard EPA approach (i.e., soil ingestion equation and assumptions) will result in very low risks (3.2×10^{-7}).[46]

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[43] Hülster and Marschner, 1993; Hülster et al., 1993; Hülster et al., 1994; Müller et al., 1994.
[44] EPA, 1993.
[45] EPA, 1993.
[46] See footnote #41.

6. We have completed an extensive, although not exhaustive, review of the literature. We have not found a study where the environmental transport of dioxins in CKD has resulted in increased levels of dioxins in plants or crops. Based on the general literature, and because of the paucity of direct studies and the preferable adsorption of dioxins to soil and CKD, it is reasonable to infer that no adverse health effects would be expected to result from the proper application of CKD.

Suggestion:

Remove this recommendation.

2) Review the range of operating conditions (including fuel/waste mixtures, maximum usage of "Sterifuel") at the kiln to determine if available air emission results are representative.

-- If conditions already tested are adequately representative, test CKD generated under the same conditions for CDD/Fs. (Air tests could be repeated at company option.)

-- If conditions are not fully representative, test both air emissions and CKD for CDD/Fs under the range of representative conditions.

Comment:

The data already exist. The fuel types used at HOLNAM have been identified and reviewed by WDOE. Dioxin concentrations estimated under various operating conditions have been shown to be below EPA's RBC and WDOE's ASIL.[47]

Suggestion:

Remove this recommendation.

[47] TRC Environmental Consultants, 1991.

3) Inventory cement kilns in Washington. Review their fuel/waste burning practices. Determine if there are data available on their air emissions or CKD.

Comment:

WDOE needs to clarify its objective(s) to determine if these recommendations help achieve their objectives. There are only two cement kilns in Washington, which means there is a very small data set, and WDOE already has this data for HOLNAM.

Suggestion:

Remove this recommendation.

4) Based on findings from steps 2 and 3:

-- Review records of sales and application sites to determine fate of CKD applied to agricultural lands. Based on findings, develop plans to sample and evaluate the effect of this application.

-- Suggest, commission, or require testing of stack emissions and CKD at other facilities as appropriate.

Comment:

If WDOE needs to collect the type of information suggested in the two above comments, then it should proceed thoughtfully and in an even-handed manner, so that emissions from all sources of dioxins are obtained.

-- Test strategies to reduce emissions of CDD/Fs including tighter control of types of auxiliary fuel/waste used in cement kilns, improved treatment of stack emissions and development of better alternatives for the disposal of CKD.

Comment:

The data do not support this recommendation, particularly since currently emitted concentrations from the HOLNAM facility are not expected to cause adverse health effects.

Suggestion:

Remove the recommendation.

-- Design a monitoring plan for the areas adjacent to known CDD/F sources to evaluate potential contamination. Base subsequent actions on the results of this monitoring.

<u>*Comment:*</u>

The data do not support this recommendation. It would be extremely difficult, if at all possible, to determine how the concentrations being detected are only coming from the source in question, especially if that source is located in an urban area.

GENERAL COMMENTS ON WDOE PAPER

1. It is not clear whether the WDOE paper is focused on human exposure to dioxins in air emissions, from CKD, or from both. It appears from the body of the document that much of the paper focuses on air emissions; however, all of the recommendations at the end of the paper have to do with CKD usage.

2. Analytical detection methods and detection limits are not addressed in the WDOE document.

<u>***Suggestions:***</u>

1. Clearly state the objective(s) and scope of the WDOE paper. Making these clear is the first step necessary in improving this paper.

2. The document should address the limitations of the data set used in the assessment:

- ***EPA Methods 8280 and 8290 are analytical techniques used to detect the presence of dioxins and furans in a variety of different media (e.g., water, soil, etc.). Method 8290 uses a higher resolution mass spectrometric method and the detection limit is more than 1000 times more sensitive than Method 8280's detection limit.[48]***

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[48] Method 8280, an isotope-dilution high resolution gas chromatography/low-resolution mass spectrometry analytical test, has target detection limits in soil in parts-per-billion [ppb]. Method 8290, an isotope-dilution high resolution gas chromatography/high-resolution mass spectrometry analytical test, has estimated detection limits in soil for each of the dioxin and furan congeners of <1 part-per-trillion [ppt].

- ***TEQs can be determined in several ways. Non-detects can be valued as zero, one-half the detection-limit value, or as the full detection-limit value. The latter value is a conservative upper estimate. Therefore, it is possible to have a dioxin TEQ value based on "non-detection." This issue should be acknowledged and addressed if possible.***

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